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OFFICE OF NAVAL RESEARCH
LONDON

EUROPEAN SCIENTIFIC NOTES

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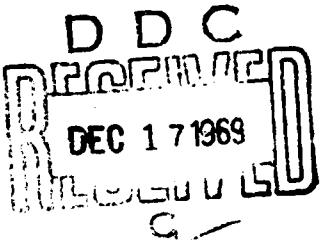

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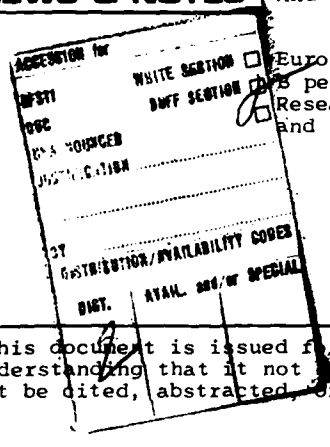
EUROPEAN SCIENTIFIC NOTES
OFFICE OF NAVAL RESEARCH
LONDON

Edited by Lawrence M. Slifkin and Victoria S. Hewitson

30 November 1969 Vol. 23 No. 11



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A.B.FOCKE
Scientific Director

W.A. HOPKINS
Captain, U.S.N.
Commanding Officer

BIOLOGICAL SCIENCES

MEETING OF THE BRITISH MYCOLOGICAL SOCIETY

Unlike the Mycological Society of America, which meets annually for several days, the British Mycological Society has several one-day meetings scattered throughout the year. These meetings usually cover a central theme such as "Utilization and metabolism of carbohydrates by fungi," which will be the subject of a meeting scheduled for 7 Nov 1969. However, there are meetings in which only general papers are read; the first of those for this academic year took place in London on 26 Sept, at the impressive Natural History Museum.

Several of the papers given dealt with fine structure. Two of these were taken from studies made in the laboratory of J.L. Gay and A.D. Greenwood at Imperial College, London. Of especial interest was the paper read by Gay, "Fine structural changes during growth and development of Saprolegnia." The roles played by vesicles in the formation of septa and exit papillae were demonstrated. Evidence was presented that the lomosomes, which are believed to play some role in wall synthesis, are composed of such vesicles and endoplasmic reticulum.

D.J. Anderson (Portsmouth) described the symptoms and curious malformation caused by a shell disease in oysters. He demonstrated two forms of fungi present: a mycelial and a sporangial. He was not able to derive one form from the other, so whether one or two organisms are present remains an open question. Immediately following this was a paper by E.B. Gareth Jones, also from Portsmouth, who discussed the fine structure of the sporangial form. Mobile spores are produced by the sporangia. These have two flagella - one tinsel and the other smooth with no whiplash. The sporangial wall was revealed to have scale-like structures that were sloughed off during development.

Other papers of interest to this writer were given by two investigators from Sheffield. J. Webster demonstrated that physical agitation was effective in enhancing sporulation of aquatic Hyphomycetes. The greater the agitation of the water, the greater the spore production - this held true even if nitrogen was bubbled into the water instead of oxygen. C. Dennis (Sheffield) read a paper entitled "Antagonistic properties of the different species groups of Trichoderma." By inverting cultures of Trichoderma over petri dishes inoculated with other fungi, he was able to show that growth of the second organism was suppressed, thereby indicating the presence of a volatile toxin. Non-volatile toxins were also demonstrated by the fact that other organisms would not grow on a medium on which the Trichoderma had previously grown. Trichoderma also had an antibiotic effect on bacteria.

This British system of one-day meetings has the advantage that one does not develop the fatigue so familiar to attendees of marathon, multi-day affairs. In a nation such as this, where a large fraction of the technical population is located in a small (relative to the US) area, this scheme seems to work rather well. (Miriam K. Slifkin, on leave from the National Institute of Environmental Health Science, Research Triangle Park, North Carolina. No official support or endorsement by the NIEHS is intended or should be inferred.)

EARTH SCIENCES

IASPEI -IAGA JOINT GENERAL SCIENTIFIC ASSEMBLY

At the last General Assembly of the International Union of Geodesy and Geophysics (IUGG) in Zurich it was agreed that the individual Associations, in groups of two or three, will hold scientific assemblies in the years between the general assemblies. An interval of four years between Association meetings is clearly inadequate considering the almost explosive growth of geophysics. Administrative and economic considerations weigh heavily against large international meetings on an annual basis. The interim joint meetings are designed to be smaller, to be primarily scientific, and to include joint symposia to induce greater interaction between Associations on selected problems of mutual interest. It is difficult to think of many geophysical problems in which such collaboration is not almost a vital necessity.

Thus, the first Joint General Scientific Assembly involving the International Association of Geomagnetism and Aeronomy (IAGA) and the

International Association of Seismology and Physics of the Earth's Interior (IASPEI) was held in Madrid, 1-12 Sept 1969. All the scientific sessions were held in the very fine facilities of the Escuela Superior de Ingenieros de Caminos, Canales y Puertos, in the university city of Madrid. The local organizing committee are to be commended for their handling of the complex administrative details as well as the very enjoyable social functions. One could only have wished that the actual program and abstracts had been distributed earlier.

The goals listed above were partially realized. The meeting was not small - 715 geophysicists were registered. It is interesting that about 40 percent of those on the preliminary list of registrants didn't arrive. The two biggest offenders were the USSR with 140 "no-shows" and the USA with 115. Perhaps this is a normal situation, I don't know, but it must make things a little difficult for the local planners. Forty nine countries were represented. The largest delegation was, of course, the USA with 206, followed by France (65), the UK (59), Canada (50), German Federal Republic (42), and the USSR (40). IAGA registrants outnumbered those of IASPEI by 353 to 240. Over 100 delegates brought 1 or more members of their family. So much for the general size and makeup of the meeting.

During the first week of the sessions, each Association held independent meetings, a feature of the IASPEI meetings being an Upper Mantle Symposium on the Structure of the Crust and Mantle beneath Inland and Marginal Seas. Interest in plate tectonics was very high in the IASPEI meetings and in the corridors. If this is a bandwagon, it is certainly crowded. The only dissenting voice I heard to the general concept was that of Prof. Belousov and even his objection, if I understood him correctly, was to investigators interpreting their data only in terms of a current popular theory and neglecting to mention other possible interpretations which may yet prove to be right. A highlight of the IAGA meetings was five half-day sessions on geomagnetic secular change. It is unfortunate that these had to be held concurrently with the IASPEI sessions. It might be noted that interaction between the two Associations was unnecessarily hindered by the fact that the programs and abstracts of each were not available to the other. The second week was primarily taken up with three joint symposia on "Multidisciplinary studies of unusual regions of the upper mantle," "Geophysical studies on the evolution of the earth's deep interior," and "Earthquake mechanics." On the basis of the papers I heard and on the comments of others, I judge that the general level of the papers was at least as high as that of previous General Assemblies.

I suspect that the meetings would have been improved, at least from the standpoint of the US attendees, if the siesta (noon to four o'clock) had been waived. It makes a long day of papers, from 9 o'clock in the morning to 7 o'clock in the evening, particularly since the siesta period rarely turned out to be a proper siesta. Certainly the attention level of those who had also attended the previous paper-filled week at Copenhagen was somewhat impaired. (R.E.Hanson)

MATERIAL SCIENCES

THE SHAPES OF SMALL MOLECULES - AN OXFORD INORGANIC DISCUSSION SPONSORED BY THE CHEMICAL SOCIETY, 26 Sept 1969

This one-day informal discussion, the eighth of a series of annual meetings, was held in the lecture room of the Inorganic Chemistry Laboratory of the University of Oxford on South Parks Road. A member of the organizing committee told the writer that when this subject was suggested for the Discussion, it was regarded as possibly rather "old hat," but consultation with leading experts in the field showed them to be unanimously enthusiastic. The committee, therefore, went ahead with it. As the first session did not start until 11:15, the majority of the 105 attendants at the meeting could leave home that morning and return after the end of the meeting at 6 p.m. Indeed, a third of the attendants registered from Oxford. The only American present appreciated it greatly when the first lecturer paused after a sentence or two to note his presence and give him a very gracious welcome.

The first session started with a brief introduction and welcome by Prof. J.S. Anderson, Director of the

Laboratory. Prof. J.W. Linnett, an outstanding theoretical man from Cambridge University, then gave a one-hour lecture, "Molecular Shapes: Theories and Hypotheses," in which he outlined the theory of the structure of small molecules and radicals and tabulated the resultant bond angles, which determine the molecular shapes, and the bond lengths, which depend on the nature of the bond. An excursion was made into more complicated molecules including the fluorides of the inert gases, some of which have essentially one-electron bonds. Large variations in the character of nitrogen and carbon bonds were shown by differences between the bond lengths and variations in bond angle from 113° all the way to 180°. These data illustrated the great changes in thinking that have occurred since the simple days dominated by the two-electron bond of supposedly constant length unless changed by effects of "resonance," a term which still has some utility as an over-simplified mode of description.

The other four talks were only ½ an hour in length. As Prof. M.C.R. Symons of Leicester was ill, Dr. P.W. Atkins of Oxford discussed "Information from ESR Measurements," He prefaced his talk by the statement that what he was about to say would not be new, interesting, or stimulating. This pronouncement, at least, sufficed to interest and amuse the audience whose interest he continued to hold. He went on to outline the methods of interpreting electron spin resonance using measurements on NO_2 and PF_5 as examples. It seems to be necessary to abandon the symmetrical bipyramid as the structure of the latter.
Dr. J.J. Turner of Cambridge gave an excellent critical survey of "The Use of Matrix Isolation Methods." Clathrates, or cage compounds, glasses, and alkali halides provide good matrices for the isolation of species for the observation of rotational and vibrational spectra, which may be markedly different in the matrix from those observed in the bulk material, where the local force field may be quite different. Condensation in a very thin layer may also provide a means of, at least, partial isolation and, of course, condensation with an inert gas has been widely used at low temperature.

Dr. A.J. Downs of Oxford discussed the question "Vibrational Spectroscopy - Guide to Molecular Properties?" Molecular shape, dimensions, and force fields enter into the picture, and their influences must be taken into account in the interpretation of data. Selection rules provide assistance, and the observation of polarized lines, which correspond to symmetrical vibrations, may provide evidence of molecular symmetry. Isotopic substitution, the study of band contours, and normal coordinate analysis are useful aids to interpretation. The answer to the question in the title would seem to the writer to be "Yes, in many cases, if skill, knowledge, and discretion are applied to the guidance." Prof. A.D. Walsh of the Univ. of Dundee has, for many years, been determining bond angles in small molecules by means of spectroscopic measurements. In "The Shapes of Small Molecules in their Ground and Excited States" he summarized the results of a great many measurements on triatomic molecules, in a manner which supplemented and amplified a portion of Linnett's lecture.

The meeting ended with a general discussion led by an eminent authority in the field, Dr. C.A. Coulson, Rouse Ball Professor of Mathematics in Oxford University and author of many publications on wave mechanics and chemistry and books on science and religion. This final hour gave opportunity for further discussion of the material which had been presented during the meeting and for comment on related topics. Nothing of great importance emerged from the discussion, but it was interesting to hear Coulson speak favorably of the calculations of molecular structures by Prof. Leland C. Allen at Princeton Univ., work which is being supported by ONR. A meeting of this sort serves a very useful purpose in that it provides an opportunity for a critical survey of an important subject and evaluation of the work done on it in a manner that is helpful to the immediately concerned expert and informative to the less concerned listener.
(C.P. Smyth)

MOTION IN MOLECULAR CRYSTALS - GENERAL DISCUSSION, THE FARADAY SOCIETY, OXFORD, 16-18 Sept 1969

Approximately 150 chemists and physicists from the United Kingdom, Western Europe, the United States, Canada, and Australia attended four half-day sessions of the Faraday

Society held in the Oxford University Laboratory of Physiology to discuss motion in molecular crystals. When the Faraday Society says "discussion," it means it; for, after an hour's introductory lecture by Dr. R.J. Elliott of the Oxford Department of Theoretical Physics, the 20 papers of the program were given with only five minutes allowed each author for presentation of the salient features of his paper. The rest of the time was allotted to discussion and the occasional informal presentation of an account of some research closely related to that described in a previous paper. The brevity of presentation was made possible by the Society's custom of mailing preprints of all the papers on the program to all attendants at the meeting who were interested and willing to part with the small fee required. The consequent well-informed discussion, which followed the presentation of two or three closely related papers, progressed on schedule under the self-effacing but firm chairmanship of Prof. Geoffrey Gee, President of the Society.

Motion in solids was examined 60 years and more ago by means of heat capacity measurements and, to a limited extent, in studies of "Restrahlen." As solid state physics developed into an important branch of the science, it was the ionic and metallic lattices which were fashionable and which were made to yield information of great basic importance and enormous practical value. The information concerning motion in molecular solids given by specific heat and dielectric constant measurements seemed for a long time to lie in the realm of physical chemistry remote from solid state physics.

In his excellent introductory lecture, Elliott drew a somewhat "tongue-in-cheek" distinction between those who were concerned with atoms, ions, and molecules containing no more than two atoms, namely, physicists, and those who busied themselves with large molecules containing more than two atoms, namely, chemists. One wondered if a physicist would lose caste if he busied himself with a pentatomic molecule such as methane, CH_4, or carbon tetrachloride, CCl_4. Fortunately, the ensuing program showed that he would not. By the end of the 1930's, heat capacity and dielectric constant measurements had given a fairly clear, semiquantitative picture of the motions in molecular solids and their relation to molecular size and shape. Thirty years later, with new investigative tools and new information available, the papers and discussion of this meeting showed progress toward a far more detailed and quantitative understanding of motion in molecular solids.

Among the most active discussion participants in this international gathering were: Prof. J. Janik of the Institute of Nuclear Physics, Krakow, Poland; Prof. O. Schnepp, Department of Chemistry, Univ. of Southern Calif., Los Angeles; Dr. C. Brot, Laboratoire de Physico-Chimie des Rayonnements, Faculté des Sciences, 91 Orsay, France; Prof. S.S. Mitra, University of Rhode Island, Kingston, R.I.; Dr. D.W. McCall, Bell Telephone Labs, Murray Hill, N.J.; Dr. J.J. Rush, Center for Radiation Research, National Bureau of Standards, Washington, D.C.; Dr. I.F. Silvera, North American Rockwell Science Center, Thousand Oaks, California; Dr. H. Stiller, Institut für Festkörper-und-Neutronenphysik, Kernforschungsanlage, Jülich, Germany; Dr. J.W. White, Physical Chemistry Laboratory, South Parks Road, Oxford; and Dr. G. Zerbi, Chimica Industriale, Politecnico, Milano. A pioneer and leader in the field of solid state chemistry, Prof. W. Jost, Institut für Physikalische Chemie der Universität, Göttingen, was among those present.

The dinner of the Society, which was held in the 700-year old dining hall of New College, attained a high standard of food and wine. In a brief speech of thanks which he had been asked to make on behalf of the overseas visitors, the writer was able to recall his attendance some 45 years ago at a meeting of the Society at which Sir Oliver Lodge and the great J.J. Thomson and Rutherford took an active part in the discussions.

The twenty papers on this program are already in print as preprints and will be published soon by the Faraday Society while the important part of the discussion will be written up for publication with the papers. Brief summaries of the papers have been given in an ONRL Conference Report. In general summary, it may be said that a third of the papers were theoretical, the results of the calculations being related to or checked against experimental information in the literature. The adjustable

parameter proved to be a particularly useful tool. Another third of the papers reported new measurements of neutron diffraction together with extensive theoretical treatment of the problems involved. The remaining third reported and interpreted new measurements of light scattering, Raman and infrared spectra, including the very low frequency infrared absorption of caged molecules, heat capacity, dielectric absorption, and briefly-mentioned nuclear magnetic resonance results. The papers were all of high quality, contributing to a broader or more detailed understanding of molecular solids. The results seemed to have no immediate practical application, but were, rather, an addition to the great body of basic knowledge from which practical applications so often develop. (C.P. Smyth)

BILLIARDS WITHIN CRYSTALS

The second week of September in southern England was a magnificent extrapolation of one of the most glorious summers ever seen in Britain, but for some 200 scientists concerned with knocking atoms about within the guts of nearly perfect crystals, it was just a week of hard work. A conference on "Atomic Collision Phenomena in Solids," attended by a diverse collection of solid state, atomic, and wayward nuclear physicists and electrical engineers, convened at the University of Sussex. This modern campus is beautifully located in the South Downs, between the substantially medieval town of Lewes - whose name itself is an Old English word for "hills" - and the resort city of Brighton (once the British center for extra-marital seaside adventures, in those far-off days when propriety suggested that such activities be concealed in anonymity).

The conference was mainly concerned with two processes: (a) the channeling of fast injected ions through the "pipes" running between close-packed lines and planes of atoms in a perfect crystal, and (b) such effects of abrupt interatomic collisions as sputtering and radiation damage. The meeting was thus a monster of two heads, both springing from a common body of interest in interatomic interactions and the effects of crystalline order on these interactions. In a sense, the two heads are complementary, since the first is what happens when the second doesn't. Moreover, the second process produces lattice defects, whereas the first is a very sensitive probe for the study of such defects. This is so because a channeled ion in effect does not "see" the perfect rows and planes of atoms, and may fly long distances through the crystal until it strikes a misplaced atom.

The topics considered at Sussex are of great current interest, especially in a number of European laboratories, several of which have large groups working on these problems. Channeling is a relatively new phenomenon. Although its existence might appear obvious to any casual inspector of a crystal model, and was indeed proposed by Stark as long ago as 1912, it actually rests on a rather sophisticated correlation of many weak interactions of the moving ion with successive crystal atoms. Thus, channeling was not experimentally established until after it appeared in the 1961 computer simulations at Oak Ridge of Robinson and Oen (See, for example, M. Thompson's lovely review in Contemporary Physics, 9, pp. 375-398). Thus, new and scientifically challenging information is now emerging. Moreover, the models used are aesthetically attractive, and the phenomena are of technological interest in connection with ion implantation doping and sputtering. It is not surprising, then, that the conference was a sell-out. Fortunately, the managerial competence of the local organizers was $\geq$ the attractiveness of the topic, and the week-long meeting went smoothly, efficiently, and pleasantly.

That old reliable controversy of past meetings - wave versus particle descriptions - seemed at Sussex to have abated somewhat. While everyone agrees that electron trajectories in crystals can be made to show features which demand a wave-mechanical treatment, the question of the adequacy of classical physics in accounting for results with heavy particles seems to rest on the degree of resolution obtainable. Thus far, it appears, any wave features in the trajectories of protons and heavier particles have still to be extracted from the background of experimental broadening.

The channeling of electrons and positrons - note that the two are quite different, since the lines of minimum potential energy for one are lines of maximum potential energy for

the other - was considered in invited review papers by J. Lindhard (Aarhus) and by M. Whelan (Oxford); the latter author discussed the electron microscopists' theory of diffraction and contrast as a wave treatment of channeled electrons. One unanswered question that arose from these two papers was that since the Lindhard theory involves the longitudinal interatomic distance, while the Whelan treatment makes use of the transverse spacing, then how could the two approach the same limit in the case of an anisotropic crystal? H. Nip and J. Kelly (U. New South Wales) described their "weavons": electron orbits bound to, and oscillating around, a line of ions in the crystal; they showed that classical theory was adequate to explain available results.

A number of the experimental papers compared the results of channeling of heavy ions, protons, and fast electrons and positrons with the predictions of Lindhard's classical model, in which lines of atoms in the crystal are represented by continuous strings. The angular dependence of channeling, the variation of this with lattice parameter and projectile energy, and the amount of contrast between random and channeled interactions - in general, these phenomena often showed rather good agreement with theory, but there were a few quantitative discrepancies.

The channeling of protons and heavy ions was considered by a number of authors. B. Appleton (Oak Ridge) and L. Feldman (Bell Tel.) showed that a uni-axial double alignment scheme, wherein emergent backscattered ions are viewed along the same channeling axis that they entered, is extremely sensitive to the presence of such crystal defects as interstitials. R. Hellborg (Aktiebolaget Atomenergi, Sweden) and S. Roth (NYU), R. Coutelle, F. Bell, and R. Sizmann (Munich) were able to distinguish between the effects of rows of halide ions and rows of cations in ionic crystals. New features in proton transmission patterns were described by L.Chadderton and F. Krajenbrink (North American Rockwell), using what the audience were assured to be quite perfect gold films. These patterns were attributed to steered orbits at angles up to twice the conventional critical angle for dechanneling. The effects on energy loss and X-ray yield of the electronic shell structure of the projectile ion were described by I. Cheshire and J. Poate (Harwell) and J. Cairns, D. Holloway, and R. Nelson (also of Harwell): the rare gas shell is the critical structure. Another Harwell paper (by G. Clark, D. Morgan and J. Poate) demonstrated that in Ge and Si the energy loss of protons in the various channels shows a simple monotonic decrease with increasing channel radius. S. Datz described the work of the Oak Ridge group on the delineation of specific orbits of ions channeled in planes in single-crystalline gold films. Only those ions which emerge parallel to the incident beam are recorded, and the discrete energy losses which are detected can be assigned to those particular trajectories in which the channeled ions execute exactly integral numbers of transverse oscillation. By tilting the crystal to increase the path length, it is actually possible to determine the oscillation wavelength associated with each energy loss group.

The statistical theory of collisions, and the resulting radiation damage and sputtering, were reviewed by P. Sigmund (Aarhus). J. Hudson (Harwell) and B. Ralph (Cambridge) showed impressive field-ion micrographs illustrating various products of vacancy aggregation after bombardment, including surface craters, internal voids, loops, and - surprisingly - highly dispersed groups of vacancies. In an invited paper, J.Venables (Sussex) reviewed his work on the electron microscopic study of the effects of the bombardment of noble metal films by low energy ions, in which previously produced vacancy stacking-fault tetrahedra are used as indicators for the presence of mobile interstitials. He showed the effects of long [110] focussons, the migration of host interstitials even at 25°K, and the trapping of mobile interstitials by substitutional impurity ions. These experiments give results which strongly indicate that vacancies become mobile in the Stage III temperature regions of the annealing spectrum, a result of some significance in the interpretation of radiation damage experiments.

Several other authors described the use of channeling to study the damage produced by ion implantation in both random and channeling directions in semiconductors. It appears,

for example, that the dependence on implantation and annealing temperatures of the interstitial fraction of the implanted ion may be quite complicated. Apparently, in certain temperature ranges the host interstitials - created by the implantation - can displace substitutional impurity ions. Other papers considered the effects of channeling, radiation damage, and diffusion on the depth distribution of implanted ions.

Among the papers dealing with the study of defects, several groups reported the determination of anisotropic threshold energies for host ion displacement. For example, M. Makin (Harwell), using the electron microscope both to produce and observe damage, obtained threshold energies for copper in good agreement with earlier values obtained by Sosin from resistivity measurements. A novel paper from CEN-Fontenay-aux-Roses (by G. Delsarte, J. Jousset, J. Mory, and Y. Quéré) described the photography of line and surface defects by use of a diffuse planer source of alpha particles. This technique relies on the de-channeling effects of defects and the changes of orientation in order to cast shadows on the detector (which here is a foil of cellulose nitrate which is later developed by etching). The Fontenay-aux-Roses group also found that the diameter of the effective de-channeling region about a prismatic dislocation is 10Å, about a third of the theoretically estimated value. Further calculations of the de-channeling effects of lattice imperfections were presented by D. Morgan (Harwell) and D. van Vliet (Sussex). In addition to corroborating Quéré's results for dislocations, they calculate the effects of relaxation about dumbell interstitials in copper and also find that vacancies have virtually no de-channeling effect. R. Kelly and H. Naguib (McMaster) discussed the conflicting tendencies of ion bombardment to produce amorphousization and crystallization, and concluded that crystallization wins out only if the crystallization temperature is less than one-fifth of the melting point.

The scattering of incident ions by the surface of a crystal was studied in computer simulations performed by M. Pryde (Liverpool), A. Smith (Manchester), and G. Carter (Salford). They demonstrated that a given scattering angle can result either from recoil from a single surface atom or after bouncing off of two or more adjacent atoms; hence, a given scattering angle can be achieved from several possible impact parameters and will involve as many different energy losses. An impressive experiment on the glancing angle scattering of helium ions from very flat, clean tungsten surfaces was presented by B. Farmery and M. Thompson (Sussex). The patterns observed appear to arise from a combination of specular reflection at the surface and a refraction of ions emerging from just beneath the surface. It was pointed out that this technique, which should be very sensitive to surface topography and adsorption, might prove of value in the study of the properties of surfaces.

High energy collisions can, of course, also produce sputtering of the surface, and an appreciable fraction of the conference dealt with this phenomenon. Evidence that sputtering can in large part be a result of backscattered ions was offered by E. Reuther, J. Bradford (Kansas State), and A. van Wijngaarden (Windsor), who found similar angular dependences of both sputtering and backscattering, and by R. Behrisch (Munich), who studied the effect on yield versus energy of sandwiching in a layer of a light element. The effect of deviations of emerging trajectories by the force fields of non-normal surfaces was demonstrated by R. Cunningham and J. Ng-Yellim (Canadian Dept. of Energy, Mines, and Resources), while evidence for an emission peak due to collision cascades within the surface was discussed by A. van Veen and J. Fluit (Utrecht). J. Colligon (Salford) and R. Bramham (RAE, Farnborough) used a radio-tracer technique to enhance the sensitivity of detection of early stages of sputtering, and found that with high bombardment energies the yield initially rises with irradiation dose. This effect persists for much longer times than can be explained by removal of contamination, and no final explanation is yet available.

Anisotropies in the erosion of sputtered surfaces were analyzed in terms of a combination of string and planar channeling by L. Francken (Brussels) and D. Onderdelinden (F.O.M. Inst. of Atomic & Mol. Phys., Amsterdam). In hexagonal metals, complicated emission patterns are obtained, and these were shown by W. Hofer and R. Sizmann (Munich) to be interpretable in terms of a superposition of several beams, plus allowance for imperfect

collection efficiences. Analysis of sputtering patterns was shown by R. MacDonald, E. Dennis, and E. Zwangobani (Australian Nat'l Univ.) to demonstrate the existence of [11] focussons in Ge, but not in Si.

In a discussion of the sputtering of insulators, E. Parilis (Tashkent) proposed that regions of high excess positive charge may be formed, thereby producing erosion as a result of a coulomb explosion. The erosion of KI by irradiation with low energy electrons or with near-UV photons (5eV) was described by P. Townsend and D. Elliott (Sussex); a peak in sputtering emission in the [110] direction is observed. The low energy threshold, the high efficiency (1 KI molecule lost per photon), and the indication of [110] focussons were taken as corroboration of the Pooley-Hersh mechanism of color center formation. In addition, several striking photographs were displayed in which the shadowing effect of microscopic, charged "pebbles" was seen to result in the formation of long, narrow, sharp cones on the underlying crystal.

The emission of photons after excitation by atomic collisions was lightly treated. I. Terzić and B. Perovic (Belgrade) discussed the quenching effect of a nearby metallic surface. Rather complex interrelations between X-ray emissions from both projectile ion and target ions were reported by F. Saris, D. Onderdelinden (F.O.M. Inst., Amsterdam) and W. van der Weg (Philips) and by J. Cairns, D. Holloway, and R. Nelson (Harwell).

A single, extracurricular session dealt with rare gases in solids. One generally measures the amount of gas released as the bombarded sample is warmed up. Alternatively, additional information may be obtained from the kinetics of gas release during isothermal anneals. If all goes well, the data yield information about trap depths and perhaps, also, trap densities. For example, for deuterium in Ni, S. Erents (Harwell) gets the same set of trap depths from both warm-up runs and isothermal anneals. P. Pronko and R. Kelly (McMaster) find two traps for Kr in RbCl; they associate the 1.2 eV trap with a single vacancy (which type of vacancy is not known), and the 2.4 eV trap with a multiple vacancy. H. Matzke (Ispra) showed that the inert gas release upon warm-up of bombarded Ge, Si, and GaAs is simpler than in most other materials, presumably because of the low self-diffusion coefficients. There is only a single process, with activation energy equal to 1.2 eV for Ge and 1.6 eV for Si and GaAs. Rather spectacular electron micrographs of faceting after rare gas bombardment were displayed by A. Art (Brussels). F. Saris (F.O.M. Inst.) described an ingenious method of determination of the gas distribution after bombardment: the intensity of soft X rays produced by excitation of the previously imbedded gas is measured as the surface is gradually sputtered away.

After the last formal session, it was announced that the next such meeting will be in 1971 in Stockholm, under the chairmanship of Ingmar Bergstrom (Stockholm). Bergstrom suggested that, to combat the expected growth in numbers of papers submitted, the scope of the 1971 meeting be somewhat narrower than the present one; he proposed, for example, that ion implantation be excluded. The present conference then closed with a presentation, by Bergstrom, of a slidesmanship medal to the University of Sussex technician who had operated the projector for a full week without a single error! On that note of good cheer, the conferees emerged into the delightful sunny Autumn with which England has been blessed this year. (L.M. Slifkin)

WANDERING ATOMS AND MOLECULES

Glasgow is a stern city of blackened granite, immersed in hearty Scottish hospitality, and surrounded by some of Britain's loveliest country. It was once the seat of the ancient and extensive kingdom of Strathclyde, and Glaswegians have commemorated this in the name of their second university.

Somewhat over a century ago, the institution now known as the University of Strathclyde was the site of pioneering research by Thomas Graham on diffusion in gases. During September 22-24, 1969, just 100 years and one week after his death, the Thomas Graham Memorial Symposium on Diffusion Processes was held at Strathclyde, under the excellent chairmanship of Dr. John N. Sherwood. It consisted of invited general lectures, addressed to the entire group, each followed by two simultaneously operating series of sessions of contributed papers. One series dealt with crystalline solids and the other with

fluids and biological materials. Only the solid state sessions are discussed in the present account, which is, therefore, a report of only half a conference.

A number of papers dealt with interstitial diffusion of metal ions in various crystals. A. Kvist and A. Bengtzelius (Chalmers U., Gothenburg) gave results on the enormous diffusion coefficients (10^{-5} cm^2/sec) of many cations in such ionic crystals as cubic alkali sulfates. They showed that for cations of a given valence the diffusion coefficient at a given temperature varies linearly with cation radius. Surprisingly, however, the slope of such a plot is negative for monovalent cations and positive for divalent cations. Rather large D's are also found (by G. Hood, Chalk River) for several solutes in the low-temperature, hexagonal phase of zirconium; the extreme example is copper, which diffuses - presumably interstitially - 10,000 times faster than the host zirconium ion. J.W. Miller (Argonne), from measurements of the effect of the fast diffuser cadmium on the self-diffusion of host lead, concluded that the predominant defect is a complex involving the association of two interstitial solutes with one vacancy. L. Barr (in the activated state of making a transition from Harwell to Paisley College of Technology, Scotland) showed that the equilibrium distribution of gold tracer in potassium crystals in a centrifugal field is that expected if the gold were dissolved interstitially.

Whether or not self-diffusion in sodium metal proceeds by an interstitial or a vacancy mechanism was a matter of some disagreement. A. Le Claire (Harwell) argued that the vacancy mechanism is strongly indicated by the agreement between the observed diffusion activation energy and the sum of the vacancy formation and migration energies, determined separately in different experiments; he proposes that the very small isotope effect (the effect of the mass of the diffusing tracer on the diffusion rate) can be explained by a great amount of sharing, in this case, of the kinetic energy of the jump process among the neighboring ions (the ΔK effect). On the other hand, calculations made by a group working with N. March (Sheffield) and R. Bullough (Harwell) suggest that the vacancy migration energy may be a good deal greater than presently available experimental values - thereby destroying the agreement with the diffusion activation energy - and that the ΔK factor in sodium cannot appreciably decrease the isotope effect. Among the various alternate mechanisms suggested by these authors, the interstitialcy seemed favored. The issue is still unresolved.

J. Philibert (IRSID) pointed out the anomalies found in diffusion in body-centered cubic metals, and G. Neumann (Osram, Munich) argued that the observations can be understood in terms of vacancies, divacancies, and dislocation effects. Divacancy contributions were also said, by H. Mehrer and A. Seeger (Stuttgart), to be evident in the recent precise data on copper self-diffusion of Rothman and Peterson (Argonne). It seems not entirely impossible, however, that small dislocation contributions at the low-temperature end of the measured range might be of importance in explaining slight curvature of an Arrhenius plot. A general treatment of the effects of thermal and electrical gradients on diffusion was given by R. Hesketh (Berkeley Nuclear Labs.)

Possible accelerations of intermetallic diffusion by plastic deformation was once a red-hot topic, but then faded somewhat when most of the observations were shown to be susceptible to artifacts. A paper in the present conference, by A. Brown (City Univ., London), concluded that any such enhancements in metals are likely to be observable only in processes in which the number of jumps per atom is quite small; e.g., aging and ordering. Moreover, Kirkendall experiments in various alloys, described by A. Vignes and M. Badia (Nancy), indicate that there is no appreciable perturbation of the diffusion process by the strains induced by the chemical gradient, and that previously reported effects of this sort are due instead to the formation of pores upon the condensation of vacancies onto impurity specks. In the valence crystal silicon, however, T. Parker (Queen Mary College, London) demonstrated on enhancement of the diffusion of phosphorus and boron as a result of the strain produced in the chemical gradient. It appears that this effect is present only when the resulting dislocations are moving, implying that it results from the generation of excess vacancies.

A number of papers dealt with the effects of variations in composition

and stoichiometry. In Ni/Co alloys, for example, an ordered structure forms at low temperatures at the composition Ni_3Co. Diffusion in this alloy system, at temperatures somewhat above the critical temperature for long-range ordering, was studied by J. Kucera and B. Million (Brno). One expects that short-range order versus composition will be maximized at the 3:1 ratio, and since the ordering lowers the free energy of the system it might have been expected that diffusion would be impeded. The experimental observations, however, are that D versus composition has a maximum, and the activation energy a minimum, at the 3:1 alloy. The effect of various impurities on the concentration of vacancies in nickel was studied by H. Helfmeier and M. Feller-Kniepmeier (Tech. Univ. Berlin), using the fast diffuser copper as a probe. W. Drake and A. Willoughby (Southampton) found that in the semiconductor silicon, the diffusion of phosphorus is enhanced by additions of the electron acceptor boron. These results disagree with earlier experiments of M. Millea, and imply that the vacancy in p-type silicon is really a donor. The effects on cation vacancies in MnO of oxygen pressure and Cr^{+++} additions were described by P. Childs (Northwestern). As the cation vacancy concentration is increased, the diffusion coefficient of Mn tracers increases, as expected, but the interdiffusion coefficient - which measures the vacancy mobility - decreases; this was attributed to vacancy-vacancy interactions. Surface diffusion may also be composition-sensitive, and J. Henrion and G. Rhead (Paris) reported enormous enhancements (X 10,000) of the surface self-diffusion of copper and gold upon exposure to vapor of lead at pressures below its saturation value, leading to surface D's approaching 0.1 cm^2/sec. These data were discussed in terms of the formation and melting of a true two-dimensional alloy on the surface.

Migration in ionic crystals was reviewd by A. Lidiard (Harwell), who also gave an interpretation of the activation energies of the removal of rare gases from alkali halide crystals. These atoms appear to migrate interstitially, with an activation energy of about 1/3 eV, but in KF can be trapped by a vacancy pair, with a binding energy of approximately 1 eV. I. Hoodless, J. Strange, and L.Wylde (Kent) presented results on conductivity and diffusion in NaI which, within experimental error, agree with the Nernst-Einstein prediction. J. Pollock and A. Tilley (Leicester Polytechnic) measured conductivity and tracer diffusion of both cation and anion in KCNS, an example of a very low melting salt. Although the melting point is only 173°C, the energy of formation of the Schottky defect appears to be as large as 3.2 eV; hence the conductivity at the melting point is abnormally low. The diffusion, however, seems to proceed via a neutral defect, and at high temperatures the two types of ion have the same diffusivity - all of which suggests the vacancy pair. Impurity tracer studies in silver halides (A. Batra and A. Laskar, et al, North Carolina) indicate that cations with d-electrons diffuse at least partially by an interstitial mechanism and that interstitial diffusion can be suppressed by the excess vacancies introduced in a halogen atmosphere.

A magnificent review of diffusion in molecular crystals was given by A. Chadwick and J. Sherwood (Strathclyde). For a wide variety of van der Waals crystals, the diffusion activation energy is close to twice the sublimation energy, and in organic solids - at least - this appears to be roughly equally divided between the vacancy formation and migration energies. The pre-exponential factors are very large, as much as 10^{15} cm^2/sec for diffusion of more complex molecules - this implies truly stupendous (in the Hollywood tradition) entropies of formation and/or migration.

A novel and promising scheme in which nuclear techniques are used for studying diffusion was described by D. Lees, J. Calvert, and D. Derry (Manchester). After diffusion of O^{18} into TiO_2, the penetration profile of the O^{18} is determined by measurement of alpha particle emission as a function of energy of an incident beam of protons. Because the (p,α) reaction has a sharp resonance, one is, in effect, scanning the concentration of O^{18} versus depth. Another new and interesting type of experiment, reported by A. Clark and J. Long (Cambridge), is the study of diffusion in minerals (in this case, nickel in olivine - a magnesium-rich $(MgFe)_2SiO_4$) in the hope of using the information thus obtained to make deductions about the cooling history of igneous minerals, from their present-day

chemical gradients. While neither of these two avenues of research is yet as quantitative as the well-developed conventional experiments, both offer exciting new possibilities for extending the field of diffusion research in the future. (L.M. Slifkin)

INTERNATIONAL CONGRESS ON METALLIC CORROSION, AMSTERDAM, 7-14 Sept 1969

The Fourth International Congress on Metallic Corrosion, organized by Netherlands member societies of the European Federation of Corrosion (principally, "Stichting Nederlands Corrosie Centrum"), was held in Amsterdam at the International Congress Centre RAI, 7-14 Sept 1969.

Thirty-five nations were represented by 675 registered attendees. The Netherlands had the greatest number of participants (153), followed by Great Britain (81), Germany (80), France (74), and the United States (47). The strongest Eastern-bloc contingents were Czechoslovakia (35) and Poland (11).

The Conference was conducted in three simultaneous sessions over a four-day period, Wednesday being left free for excursions, both scientific and "touristic." Approximately 125 papers were presented under two general themes, Corrosion Processes and Protection against Corrosion. The areas of research receiving most attention were concerned with stress corrosion cracking, corrosion processes under the influence of applied potential, and high temperature oxidation mechanisms - in the latter case, particularly, the beneficial role of minority components in improving corrosion resistance. Most of the findings reported would have to be classified as evolutionary rather than revolutionary, however.

One of the better papers was the plenary lecture by Prof. Staehle (Ohio State U.) which provided an especially lucid and informative review of modern stress corrosion cracking (SCC) theories. Staehle emphasized that stress corrosion is a widely found phenomenon which occurs not only in high-strength alloys but also in elemental metals, glasses and plastics in numerous environments. A goodly part of his address was spent demolishing the corrosion researcher's dream - the finding of a single mechanism which underlies all stress corrosion reactions. This, according to Staehle, is not likely to happen. And his view is evidently widely shared, for the papers of the Stress Corrosion Session were marked by pragmatism, the authors holding mainly to a simple reporting of experimental observations capped by a statement that these results did or did not appear to support this or that SCC theory. A refreshing exception to this trend was Prof. Uhlig (MIT), who (rightly or wrongly) set down three conditions which he considers have to be met before stress corrosion cracking is possible.

One new clue in SCC was revealed by Dr. Keys (U. of New South Wales, Australia), who showed that there is strong H_2 evolution just prior to cracking for austenitic stainless steels in boiling magnesium chloride solution. Advocates of the "film rupture" theory of SCC (including myself) were enheartened.

Three papers in the Passivation and Anodic Protection Session were noteworthy for their promise of new insight into the elusive nature of the "passive film" Dr. Kruger (NBS-USA), working with iron, and Prof. Okamoto (Hokkaido Univ., Japan) studying stainless steel, both reported a change in the nature of the passive film formed by anodic polarization if the polarization were carried out above a certain critical potential. This change was demonstrated in the first instance by a lessened resistance to chloride ion attack, but in the second, conversely, by an increased resistance to both dry (O_2, 438°C) and wet (time to self-activation in 30% H_2SO_4) corrosion. The significance of this E_{crit} is uncertain yet, but I am sure that we shall hear more from both authors on this point in the future.

Prof. Bianchi's group (U. of Milan) in Italy has found that temperature can also be a critical parameter in passive film formation. Stainless steel passivated in dry air at 200-300°C was much more susceptible to pitting in NaCl solution at +450mV (NHE) than steel passivated at either higher or lower temperatures, according to their observations. The Tafel relation for the redox reaction, $Fe(CN)_6^{+3} \rightleftharpoons Fe(CN)_6^{+2}$, indicated anodic transfer coefficients of 0.2 and 0.7 for the pitting and non-pitting films, respectively, leading Prof. Bianchi to conclude that the former was probably a p-type and the latter an n-type conductor.

The papers presented by Huybregts

(Arnhem, Netherlands), Jones (CERL, England), Townsend (Bethlehem Steel, USA), and others gave evidence of the increasing interest in high-temperature electrochemistry and thermodynamics. Townsend's paper may prove particularly useful, since he sets forth methods for preparing Pourbaix diagrams for metal/H_2O systems at temperatures up to 300°C (or higher, since the method is general).

Although instruments such as the scanning electron microscope and electron probe are now used in this pursuit, most papers in the High Temperature Oxidation Session reported research carried out along traditional paths; i.e., where the corrosion behavior of an alloy as a function of a minor component, gas pressure, etc., is explained in terms of various structural features or compositional changes found in the corrosion product film formed on the alloy surface. One interesting attempt to expand this approach is being made by Holmes' group at the Central Electricity Research Laboratories (England). They hope, by studying the conductivity and thermoelectric power of "doped" oxide solid solutions, to identify oxide compositions which give minimum defect concentrations and should therefore be especially protective. Then, working backwards, they hope to formulate alloys which will produce films, when subjected to the working temperature, of the specified composition. Success to present, however, has lain mainly with $(Fe, Cr)_2O_3$ where a conductivity minimum, reflecting a change from p- to n-type conductor, was found at 5-7 mol %Fe_2O_3, this oxide composition resulting at 16-20% Cr in Fe/Cr alloys. But the scheme is appealing, and work continues.

The Proceedings from this Fourth International Congress on Metallic Corrosion will be published by the National Association of Corrosion Engineers (Houston), with publication projected for 1970. (R.L. Jones, U.S. Naval Research Laboratory)

ILLUMINATED CRYSTALS - THE TENTH EUROPEAN CONGRESS ON MOLECULAR SPECTROSCOPY

Although, as the title implies, these conferences are a relatively old institution, the Tenth Congress represented something of a new departure. The content of this conference, and presumably future ones, was limited to a single topic within the broad field of molecular spectroscopy. The topic chosen for the Tenth Congress was the Optical Spectroscopy of the Solid State. This limitation of breadth was immediately successful in one sense; that is, the number of participants, a comfortable 300 or so, was less than half the number of participants at the Ninth Congress two years ago in Madrid. More important was the uncommon and stimulating mix of people and problems attracted by this particular topic.

The conference took place at the University of Liège, Belgium, during the week of 29 Sept. The daily sessions convened on the new campus at Sart Tilman, located roughly four miles from the center of the city. This necessitated a half-hour bus ride to and from the hotels for most of the participants, a minor inconvenience. The facilities were good, with the sessions taking place in three large modern lecture halls in a building shared by the chemistry and physics departments and filling this function alone. The International Union of Pure and Applied Chemistry was sponsor, and the organizing committee was under the chairmanship of Prof. B. Rosen. As secretary of this committee, Prof. J. Depireux very capably carried the tedious burden of making the actual arrangements and managing the conference machinery. Roughly thirty percent of the conference attendees were French, fifteen percent German, fifteen percent Belgian, ten percent American, with the remainder coming primarily from other European countries.

Each morning began with an hour long introductory lecture, and three parallel sessions competed through the remainder of the day for the attention of the conferees. The subject matter was organized loosely into four sections: infrared and Raman spectra, electronic spectra, charge transfer complexes, and matrix spectroscopy. The first section comprised roughly half the conference, although it will receive considerably less than half the attention in this resume. From the large total of presentations, that small fraction mentioned below was chosen purely on the basis of the writer's interests and capacity for assimilation. The coverage of the four sections will be highly nonuniform, partly due to the constraints imposed by parallel sessions.

The welcoming address by Prof. Rosen which opened the Congress was

followed by an introductory lecture by Prof. J.P.Mathieu (Faculté des Sciences, Paris) on recent progress in the Raman spectroscopy of solids. This was a broad discussion delivered in the grand manner and covering in an elementary way some of the high points of recent work on ionic and molecular crystals and on theory.

The introductory lecture of Prof. F.C. Brown (Urbana) concerned a rather more specialized field, the optical properties of solids in the far ultraviolet. His group is doing absorption spectroscopy on thin films, using the synchrotron radiation from the electron storage ring at the University of Wisconsin. The primary objective is to probe the band structure of solids by exciting transitions from deep core states to the vicinity of the Fermi surface. In aluminum, for example, they see a spin-orbit split edge at about 70 eV corresponding to a transition from the 2p band to the Fermi surface, and there is preliminary evidence for a many-body enhancement of this edge. In alkali halides, much of the structure seen is essentially atomic in nature, but solid state effects are evident in a number of temperature dependent transitions to p-like conduction bands states of the crystal. This interesting use of synchrotron radiation has also engaged the efforts of groups at Hamburg and Tokyo. R. Haensel discussed part of the broad program based on the electron synchrotron at Hamburg. They have work in progress on the light metals, transition metals, alkali halides, solid rare gases, and semiconductors. Haensel talked mainly about rare gases, where the absorption is similar in the solid and gas phases except for some sharp structure due to solid state effects. Antiresonances due to the superposition of two alternative transitions are evident in solids just as in gases. The friendly competition among these three groups and others appears likely to provoke a large outpouring of interesting data in the next few years.

Prof. S. Nikitine (Strasbourg) gave the introductory lecture on excitons. After lodging the not unreasonable protest that the undiluted topic was much too large for one lecture, he proceeded to review recent work by the Strasbourg group on mainly the oxides and halides of copper. His obligation to the audience was not seriously breached, however, as these materials have for many years served as model systems for much of exciton physics. Nikitine is maintaining a large effort in this area, the most interesting aspect of which is the increasing utilization of electro- and magneto-optic effects to verify the nature of the various exciton transitions observed. In this connection, C. Wecker of the Strasbourg group discussed measurements of Zeeman effect in the exciton spectra of CuBr. There are indications of field induced transitions to a triplet (J = 2) exciton state. A similar transition has previously been observed by the Strasbourg group in CuCl. This identification was verified in a later paper on CuCl by W. Staude (Frankfurt), who also reported what he believes to be the first identification of a transition to the longitudinal exciton state. This transition appears as a weak field induced line on the high energy side of the first exciton line. These measurements, as well as the electro-reflectance spectra described by E. Mohler (Frankfurt), yield values for the spin-orbit coupling and the electron-hole exchange parameters for the exciton. Agreement between these two determinations was excellent, and the overall conclusions reached by the Frankfurt group were in essential agreement with those of Nikitine and coworkers. The latter group also contributed an interesting paper by J.L. Deiss on the electric field enhancement of the 1s quadrupole exciton transition in Cu_2O and a paper by J. Biellman on spacial dispersion in PbI_2.

G. Baldini (Milan) described his recent work on exciton transitions in alkali halides. The new twist here is to measure reflectivity on crystals cleaved in vacuum at low temperature. The well-known exciton lines are now much sharper and in many cases reveal new structure. For instance, the low energy n = 1 excitons in LiBr and NaBr are split by what Baldini believes is a local mode vibrational frequency, while the n = 2 exciton in KI shows splittings close to the LO- phonon frequency. This is reasonable, since the larger radius exciton (n = 2) should couple relatively more strongly to the lattice. K. Vacek (Charles University, Prague) gave evidence for a biexcitonic complex in AgCl excited by ultraviolet laser light. A structured luminescence band whose intensity approaches quadratic

dependence on the incident laser intensity furnished the data whereby the complex was identified. The measured energy binding the two excitons, 154 cm^{-1}, is in good agreement with theory.

At the half way point of the conference, the infrared and Raman section was again prominently represented through an introductory lecture by Prof. A. Hadni (Univ. of Nancy) on new trends in the far infrared spectroscopy in solids, both inorganic and organic. J.A. Koningstein (Carleton Univ., Ottawa) described laser excited electron Raman effects involving the Zeeman levels of rare earth ions in aluminum garnet. In general, experiment and simple theory compare here very nicely.

Localized transitions in partly filled shells was the topic of Prof. C.K. Jørgensen (Geneva). He argued that the similarity between the visible and near-ultraviolet spectra of many chromophores in crystalline, vitreous, and liquid states implies that the energy band description is not appropriate for the excited levels involved in the transitions. The physicists were mildly taken to task for pressing band theory concepts a bit too far, although this writer would be hard pressed to find illustrations of this situation in systems which physicists have really thoroughly studied. Jørgensen discussed the effects of ionization energy, electron affinity, Madelung potential, ligand fields, and the like both on transitions within partly filled shells of small average radius and in charge transfer transitions. His presentation was spiced by a spectacular array of examples of many chemical species.

Thereafter, several interesting papers were presented which indirectly supported Jørgensen's thesis in areas which he failed to mention. One was work by K. Maier (Frankfurt) on the determination of the symmetries of excited states in the absorption spectrum of KI:Tl as determined by sensitive ac uniaxial stress techniques and polarized light. Conventional excitation or transfer models fail to furnish a sufficient number of excited states with the measured symmetries. Quite spectacular success was achieved, however, by constructing excited states as molecular orbitals including both I^- and Cs^+ atomic orbitals. A similar success was reported by M.A. Aegerter (Utah), this example involving the F_2^+ center in KCl crystals. Numerous absorption and emission transitions of this center were identified, and their energies were found to correspond very closely to those of an H_2^+ molecular ion corrected by using an effective dielectric constant and the separation between the two protons as adjustable parameters. It would be interesting to understand why such an unrealistic model turns out to give such close agreement with experiment.

Continuing along the vein of the two papers just above, we will here take brief note of several papers representing the field of color centers in inorganic crystals. Although certainly not predominant, this field contributed substantially to the content of the Congress. The Darmstadt group was represented by the papers of F. Lanzl and W. von der Osten. The former discussed the electron-phonon interaction in color centers with particular reference to those alkali-halide F-aggregate centers which show distinct phonon structure in their optical transitions, while the latter reviewed the methods by which splittings of zero-phonon lines in crystals under applied stress and electric fields can be analyzed to determine the symmetries of the centers responsible. G. Spinolo (Milan) reported new data on the lifetimes of the relaxed excited states of F centers in alkali halides. The utilization of photon counting techniques has yielded data covering four orders of magnitude in the luminescent intensity. At a given temperature, the lifetime was found to be independent of F-center concentration while, as is well known, the luminescent efficiency does depend on concentration. This situation was interpreted in the usual way on the basis of a nonrandom distribution of F centers; close pairs quench (via electron tunnelling) but do not radiate, separated F centers luminesce but do not quench.

W.A. Sibley discussed the complex optical absorption and emission due to the several types of M center in MgF_2 which the Oak Ridge group has succeeded in sorting out. He also described optical work which reveals a virtual coincidence of the principal optical absorption bands due to the F and F^+ centers in MgO. The emission bands, are, however, separated by roughly 0.4 eV. S.S. Mitra (Rhode Island) discussed the spectra of U centers, and emphasized the apparent

fact that local modes due to the hydrogen (or deuterium) do not contribute appreciably to the broadening of the well-known ultraviolet absorption band. This broadening is caused primarily by optical phonons, as is the case for the F center.

D. Schoemaker (Argonne Nat'l Laboratory) described recent ESR and optical absorption spectroscopy of the V_1 center in KCL:Li. The V_1 center was previously identified as an interstitial halogen atom adjacent to and stabilized by a substitutional alkali ion impurity. The interesting new feature here is that the Li-stabilized center has a different geometry from the previously observed Na-stablized center, presumably due to the ion size difference. Otherwise, these two varieties behave similarly. Double injection electroluminescence from self-trapped excitons in KI was discussed by C. Paracchini (Parma). His model entails the double injection of electrons and holes from metal colloids into the crystal. The injected holes are self-trapped to form V_k centers, and upon field reversal the injected electrons recombine radiatively via self-trapped exciton states.

The polaron problem received a good share of attention both in the formal contributions and in informal discussions involving J. Devreese, R. Evrard, and E. Kartheuser (Liège), G. Ascarelli (Purdue), F. Brown (Urbana), and others. Although the theory of free polarons by the first three may not yet be directly applicable to some of the more important data, it nevertheless allows some interesting qualitative comparisons with, for example, Ascarelli's dynamic piezo-optic data on exciton states in AgBr. Discussions of the concepts involved were particularly illuminating for a non-specialist in the field.

Finally, mention should be made of two papers from the small matrix isolation spectroscopy section, an introductory lecture by K. Dressler (Zurich) and an invited paper by M. Rochkind (Bell Labs). Dressler spent most of his time on a particular problem in solid nitrogen involving an emission line which exhibits an anomalously large matrix shift. His new explanation depended on the existence of vibrationally hot N_2 molecules in the solid, even at liquid helium temperature, and this possibility he made quite plausible. Rochkind discussed the method of pseudo matrix isolation, which involves the pulsed condensation of diluted gas mixtures onto a cold ($22^{o}K$) substrate. He argued effectively that, due to quenching of rotation, this method actually gives better infrared spectra for molecules than do measurements on the gas phase. There are many promising uses for this technique, among which are the analysis of complex mixtures, certain photolysis reactions, reactive species, and measurements of diffusion through thin films.

Although the conference as a whole offered few striking new discoveries in the formal presentations, it did seem to serve quite a useful interdisciplinary function in bringing together organic and inorganic materials, molecular and color center spectroscopists, chemists and physicists, etc. This cursory review gives inadequate indication of the cross fertilization which went on, and this is of course difficult to judge in the long run. It was, however, certainly a pleasant and productive week for the participants and a credit to the organizers.
(M.N. Kabler, U.S. Naval Research Laboratory)

MATHEMATICAL SCIENCES

EUROPEAN SHELL GAME

A near-ultimate in meeting saturation for a specific discipline was achieved early this fall when three separate conferences dealing with shell structures were held within a span of three weeks. Leading the procession was Euromech 15, a Colloquium on the Problems of Mechanics in Shells Undergoing Finite Deformations, held at the University of Orsay, France, 15-18 September. This was followed after a week's respite, by partially overlapping meetings; the First International Conference on Pressure Vessel Technology in Delft and The Hague, 29-September - 2 October; and the International Colloquium on (Previous) Progress (and Future Development in) Shell Structures in Madrid, 1-3 October.

Euromech colloquium topics are quite specialized and attendance is limited to European scientists and is by invitation only. (The writer used his London address and went disguised

as an Englishman, fooling no one.) The purpose is to bring together those who are active in the field, particularly the young scientists who are embarking on some of their first independent research. Because participation is largely by those with university affiliations, the subjects treated often have the flavor of classroom examples for some of the advanced graduate courses. This year, arrangements for the meeting were the responsibility of Prof. R. Mazet (Université d'Orsay, France), and a program of approximately 24 papers was set up.

Organization of a new conference, even on a national scale, calls for considerable effort. That is why the sponsors of the First International Conference on Pressure Vessel Technology - the Pressure Vessel Division of the American Society of Mechanical Engineers and the Koninklijk Instituut van Ingenieurs, Netherlands - are to be admired for their courage and commended for their skill in carrying through a well-balanced conference. If attendance is any measure of interest in the subject, then the sponsors must be encouraged by the final attendance figures of over 750 persons.

The International Association of Shell Structures represents a coalition of structural engineers and architects having as their objective the analysis, design, development and construction of shell structures. The Colloquium this year had as its theme a review of past accomplishments and prediction of future achievements - a form of memorial to its first president and founder, the late Dr. Eduardo Torroja. The present president, Prof. Dr. ir. A.M. Haas (Technische Hogeschool, Delft), has for many years inspired the cooperation and communication between the normally quite separate factions of architects, analysts, engineers and constructors.

As can be seen from these brief descriptions of the sponsoring organizations, their membership and purposes have very little in common. However, these particular meetings all possess papers dealing with shell theory, analysis and experiment. This somewhat tenuous common thread will be used to connect related papers from each of the meetings. A more or less natural sequence will be shell statics, dynamics and stability. Reference to the appropriate meeting will be through the rather obvious designation Euromech, PVT or IASS.

Statics. The special interests served by PVT and IASS are best exemplified by categories like tube sheets, juncture stresses and creep (of direct concern to PVT), and architecturally popular shell shapes such as folded structures, free form and hyperbolic paraboloids (the latter being well know to IASS members as hypars). On the first subject, the careful plane stress analysis by Dr. P. Maijers (Inst. TNO, Delft) of stress distributions around circular holes in a doubly periodic array due to arbitrary edge loads was particularly warmly received. Based on Meijers' doctoral dissertation at Delft (which in turn extended some of the basic work reported ten years ago by Prof. W.T. Koiter, Technische Hogeschool), the paper provides detailed curves of stress concentrations for square and equilateral triangle arrays. Photoelastic work on the latter array was given in a separate paper by Drs. H. Fessler and J.K. Musson (Univ. of Nottingham, England), who loaded their specimen in uniaxial tension and obtained both elastic stress distributions and elastic-plastic strain difference ratios in the ligaments. Examples of combined theoretical and experimental analyses of stress distributions in tube sheets were given in the papers by T. Slot (General Electric Company, N.Y.) and by F. Arav (Stork Company, Hengelo, Netherlands), et al.

The juncture stress problem arises, as all shell designers know, because the beautifully symmetric pressure vessel is always ruined by intersections with pipes which transfer the working fluid. At the PVT meeting, various techniques were used to calculate stresses at such intersections: the finite element method was employed by N. Prince and Y.R. Rashid (Gulf General Atomic Inc, California); series solution approaches were used independently by Prof. D.H. van Campen (Univ. of Technology, Delft) and by Prof. N.C. Lind (Univ. of Waterloo, Ontario); and limit analysis was used by Prof. J. Schroeder and P. Rangarajan (Univ. of Waterloo, Ontario) to obtain an upper bound to the limit pressure.

On the subject of creep, a full PVT session was devoted to the subject. Representative examples of the papers were calculations of creep strains and deformations in thick-walled cylinders by R.G. Patton, et al. (The Queen's University of Belfast, Ireland) and an exact analysis by Prof. R.K. Penny (Univ. of Liverpool).

At IASS, analysis of folded structures, free forms and hypars was treated in a number of papers. To the jaded meeting-goer, these shell shapes offered considerable relief from the more commonplace shells of revolution; to the analyst and designer they often offered great surprises. Folded structures, it may be argued, are practical examples of finite elements, although none of the papers adopted that point of view. Instead, boundary equations were studiously developed and applied. With free form shells, the shape may be visualized as the one obtained by attaching an extensible membrane to the desired boundary frame, inflating it and freezing (rigidized) the entire assembly. The shell thus produced is inverted and supports loads directed opposite to those which formed it. To calculate the membrane stresses induced, one must know the surface geometry accurately, and the papers dealing with this subject provided methods for predicting or measuring the desired quantities. Proper mounting of the hypar is crucial in the design, and various methods and examples were described in the papers.

Another shell shape common in architecture is the second order surface. IASS papers devoted to this subject were given by Privatdozent Dr.-Ing. J. Eibl (Technische Universität Braunschweig, Germany) who used the method developed by Vlasov to treat doubly-connected domains (i.e., membrane shells with holes); and by Prof. Y.-M. Giroux and G. Bonnes (Laval University, Quebec) who used finite element techniques to calculate stresses on elliptic paraboloids; and by S.H. Simmonds (University of Alberta, Edmonton) and D.H. Quapp (Bridge Branch, Province of Alberta, Edmonton) who used a nodal finite element method for an elliptic paraboloid of rectangular plan. In this connection, the finite difference method described at Euromech by Prof. H. Weinitschke (Technische Hochschule, Berlin) using the ADI (alternating direction implicit) integration scheme should be mentioned. Weinitschke has found this method attractive because of its rapid convergence and error estimate when used for shells of rectangular plan.

However, it is no secret that finite difference techniques are rare these days; with the exception of Weinitschke's work and method used for general shell shapes described at IASS by Prof. L. Lachance (Laval Univ., Quebec), all other numerical analyses on the programs made use of the finite element technique. A paper by Dr. C. Brebbia, et al (Southampton Univ.) at IASS provided a useful survey and bibliography of the subject. Along these same lines, Dr. K.E. Buck, speaking at PVT for Prof. Dr. J.H. Argyris (Technische Hochschule, Stuttgart) described Argyris work on both two- and three-dimentional elements. The latter in particular are receiving increasing attention by analysts faced with determining stresses in non-symmetrically loaded thick-walled pressure vessels. As examples of rather general procedures for numercal shell analysis, the PVT papers by Prof. P.V. Marcal (Brown Univ.), by Meijers, by Prof. E.V. Popov and S. Yaghmai (Univ. of California, Berkeley) should be cited.

If use of finite element methods is on the rise, then it would seem that other previously well-established techniques must suffer. Limit analysis appears to fall under this heading. Other than Schroeder's treatment of the juncture problem mentioned previously, only the analysis of Dr. M. Janas (Academy of Sciences, Poland) and the experimental work by Dr. D. Newton (University of Suffolk), both given at Euromech, represented new contributions to the field. Janas' analysis, as described by Dr. A. Sawczuk (Academy of Sciences, Poland), dealt with the effects of combined bending and membrane action on the collapse of panels, while Newton's work dealt with confirmation of predicted collapse loads of circular plates and cones.

Dynamics. Papers on this subject were almost non-existent: just one contribution each from PVT and IASS. In PVT, one analysis on the response of a rigid-plastic tube to an impulsive ring load appeared. Carried out by C.K. Youngdahl (Argonne National Laboratory), the study provided curves of maximum radial displacement vs impulse level for various pulse shapes. In IASS, Prof. G. Herrmann (Northwestern/Stanford) described work carried out at Northwestern on free and forced vibrations of cylindrical shells and of dynamic interaction of cylindrical shells with a surrounding fluid. Analytical and experimental results were cited.

Stability. In this category, the most popular shell shape is still the circular cylinder. Reports on the continuing study at the Institut für

Flugzeugbau, Deutsche Forschungs- und Versuchanstalt für Luft- und Raumfahrt at Braunschweig, Germany, were made at both Euromech and IASS by Prof. Dr. -Ing.M.E. Esslinger and Dipl.-Ing. B.M. Geier, Careful experiments on axially compressed or externally pressurized unstiffened or orthotropically stiffened Mylar cylinders were described. Effects of initial imperfections were included and analytical results were presented. The massive seven-chapter, 42-reference contribution by Esslinger and Geier in the IASS proceedings should be of interest to the student, researcher and designer.

Application of small deflection and postbuckling analyses to axially compressed concrete cylindrical shells together with some experimental data was described by IASS President Haas. And at Euromech, Dr. S. Lukasiewicz (Academy of Sciences at Warsaw, Poland) showed how the influence of initial paraboloidal or hyperboloidal imperfections on the buckling of the axially compressed cylinder could be predicted semi-quantitatively by means of a rather simple membrane analysis.

In connection with other shell shapes, Prof. T. Barta (speaking for Prof. A.H. Chilver, his colleague at University College London) discussed at Euromech Chilver's continuing study of postbuckling behavior as characterized by symmetric and/or non-symmetric postbuckling patterns. Examples cited were axially loaded toroidal shells, externally pressurized oblate and prolate spheroids and shallow spherical caps. Work dealing with three specific examples of non-cylindrical shells should also be mentioned: transversely loaded doubly-curved shells of rectangular plan form by dott. ing. A. di Tommaso and Prof. dott. ing. A. la Tegola (Istituto di Technica delle Costruzioni at the Univ. of Naples, Italy); transversely loaded hyperboloidal shells by J.G.A. Croll (University College, London); and externally pressurized "free-form" shells by Profs. J.R. Salmons and K. Buchert (Univ. of Missouri). Di Tommaso presented the results of his analysis at both Euromech and IASS: the particular example was the simply supported elliptic paraboloid. Effects of initial imperfections, material nonlinearity and viscoelasticity were calculated for certain of the load and geometry parameters. Concern over the dramatic failures of hyperboloidal cooling towers prompted the experimental study by Croll; a polyvinylchloride model, spring-supported at its base, was transversely loaded at selected points below the top, radial deflections under the load were measured, and snap loads were reported. Salmons' free form shell had a circular plan and was composed of four or six doubly-curved subshells of triangular plan. Radial arches joined the subshells. External pressure was applied to the model (a fiberglass and epoxy resin composite) and critical loads were recorded. Approximate analyses gave satisfactory agreement with experimental data. Both Croll's and Salmons' work was reported at IASS.

A quite general computational approach to the calculation of buckling loads as well as vibrational frequencies of orthotropic shells of revolution was described at PVT by Dr. D. Bushnell (Lockheed, Calif.). Several examples were cited to exhibit the generality of the method.

At Euromech, two papers on inelastic buckling were presented: Prof. F.A. Leckie (Univ. of Leicester) promoted the use of rate equation technique (as used in the works of Hill, Onat, Biot and Batterman) in the calculation of plastic buckling of boss-loaded hemispherical shells; and Dr. L.Å. Samuelson (Flygtekniska Försöksanstalten, Stockholm) described his analytical numerical method for calculating creep buckling of shells of revolution under quite general loading conditions. A particular example in Samuelson's paper was an old friend, the axially compressed cylindrical shell. Creep buckling of boss-loaded spherical shells was described at PVT by Prof. R.K. Penny and Dr. D.L. Marriott (Univ. of Leicester), who obtained a rather simple analytical technique for predicting collapse times. Agreement with experimental data was quite good.

Also presented at Euromech and worthy of mention although defying the usual definition of a shell were the papers by Dr. Z. Wesolowski (Academy of Sciences, Warsaw, Poland) on the stability of an externally pressurized thick-walled hollow sphere of rubber-elastic material (analysis and experiment); by Prof. A. van der Neut (Technische Hogeschool at Delft) on the influence of geometric imperfections of flanges in axially loaded columns on the buckling load; and by Prof. K.C. Rockey (University College of South Wales

and Monmouthshire at Cardiff) on the post-buckling plastic behavior of shear-loaded web plates.

It was clear that considerable planning had gone into all three of the meetings. Actual details on the mechanics of the arrangements differed because of the differences in the number of attendees. Thus, the Euromech registrant (one of 30 or so) could expect to be greeted personally by Prof. and Mme. Mazet, while the impersonal bustle at PVT where over 750 persons were registered closely resembled the Winter Annual Meeting of the American Society of Mechanical Engineers. Emotions were most mixed at IASS where a lovely señorita greeted you with a smile and over 10 pounds of Colloquium Proceedings.

While no translation services were required at PVT, English being the only official language, "simultran" headsets were provided at IASS where English, French and Spanish were all used. Members of the audience at Euromech volunteered to act as English or French interpreters, although Prof. M. Crochet (Université Catholique de Louvain, Belgium) had the best solution: during his presentation, he described his recent work on large deformations in inextensible Cosserat plates in English and in French, a paragraph at a time.

Even now plans for future meetings of PVT and IASS are in the advanced stages. IASS is particularly well-organized in this respect: announcements of next year's meeting at Vienna on 28-30 September (theme: Folded Structures) have already been distributed, and arrangements are being made for the 1971 meeting to be held in Hawaii, with Submarine Structures as the theme. (W.E. Jahsman)

MISCELLANEOUS

A NEW POLICY FOR ISRAELI NON-MILITARY SCIENCE EXCLUDING ACTIVITIES OF THE ATOMIC ENERGY COMMISSION

In May of 1966, Mr. Levi Eshkol, then Prime Minister, appointed a "Committee to Inquire into the Organization and Management of Governmental Research." This group was asked to study the current governmental research establishments and to make recommendations which should result in more effective organization and operation.

This spring, the Committee submitted its report which has been under consideration since, by the Board of Directors of the "National Council for Research and Development" in the Prime Minister's Office.

The report is lengthy, spending a hundred pages on background material concerning: Terms of Reference; The Role of the Government in R&D; The Effort in R&D; The Government Research Institutes; Existing Organization and Adminstration of Government Research Institutes; Liaison between Government Institutes and Institutions of Higher Learning; and The National Council for R&D.

The recommendations by the Committee propose the creation of a new organizational structure for government action in R&D which will involve groups and work at three levels: national, ministerial, and research institute.

The central national body, the Research and Development Authority, being given the necessary authority and means of accomplishment, should (1) propose to government an all-national policy for scientific research and technological development, (2) furnish government with its views on the budgets of government ministries for R&D in relation to their goals, priorities and distribution; (3) coordinate the R&D activities of the government ministries and (4) advise government on the initiation and closure of government research institutes. The Authority would report directly to the Prime Minister or to an individual minister who is designated for this purpose. The National Council for Research and Development would serve as the initial nucleus for this Authority. (A minority of the members of the committee questioned the need for this new Authority on the grounds that the National Council now exists and that it could be granted the required added authority and scope without change of name or personnel.)

Each ministry should: (1) determine the needs of R&D in the subjects for which that ministry has responsibility and establish their priority; (2) assure adequate budgets to provide for the requirements of research and to appropriate such funds to research groups in keeping with the policies of the ministry; and (3) encourage research and the application of science and technology in the area of

the ministry's responsibility. Within each ministry a chief scientist should be appointed and be assisted by a group to be known as the "Chief Scientist's Bureau." It was recommended that a Chief Scientist's Bureau be created promptly within the Ministries of Agriculture, Commerce and Industry, and Development and Health and that the need for such bodies in the Ministries of Post, Transportation and Housing be further explored.

The Committee recommended the establishment of three legal corporate bodies, to be called Research Administrations: The Agricultural Research Administration to be attached to the Ministry of Agriculture; the Industrial Research Administration to be attached to the Ministry of Commerce and Industry; and the Environmental Research Administration to be attached to the Ministry of Development and Health. The Ministry Chief Scientist should be the chairman of the Board of Directors of the respective Administration, and the Government research institutes would be placed under the appropriate Administration. The Minister would appoint the Board of Directors of the Administration and its budget would be guaranteed by the Ministry. The Administration in coordination with the Chief Scientist's Bureau would administer and coordinate current operations of the Institutes in the prosecution of definite research projects. (The establishment of the Research Administrations as corporate bodies was objected to by the minority of the Committee on the grounds that it is quite possible to conduct research and development successfully under a Civil Service organization and that the prosecution of Government research under the two systems would be very difficult. The Ministry of Defense research is performed under Civil Service.)

A considerable number of detailed recommendations increased the length of the report to some 120 pages. Much of this note has been taken from the report itself and from a summary circular prepared by Dr. Eliezer Tal, Director of the National Council. (A.B. Focke)

OCEAN SCIENCE & TECHNOLOGY

INDIAN ESTUARINE SYMPOSIUM

In recent correspondence with Prof. P.J. Sanjeeva Raj, Department of Zoology, Madras Christian College, Tambaram, Madras-59, India, reference was made to the First All-India Symposium in Estuarine Biology. The Symposium will be held at Madras Christian College, 2 -30 December 1969. It will be sponsored by the University Grants Commission of India and chaired by the Director of the Marine Biological Laboratory at Porto-Novo, R.V. Seshiaya. Dr. N.K. Panikkar, Director of the National Institute of Oceanography, Goa, has been invited to deliver the inaugural address. Prof. Sanjeeva Raj indicated that approximately 50 participants will be present from all over India and will read papers on a number of different aspects of estuarine biology. Included in the three-day session will be a field trip to Pulicat Lake, the second largest, brakish water lake in India, and also to the Estuarine Biological Laboratory of the Madras Christian College at Pulicat. Abstracts of the papers to be presented, as well as the proceedings of the symposium, will be published and individuals interested in purchasing copies should contact Professor Sanjeeva Raj.

Although India has attempted to develop an oceangraphic program, there has not been any coordinated interest in estuarine research. There are a number of major rivers and large lakes, Chilka Lake, Pulicat Lake, and Vembanad Lake, with sizable areas of brackish water. Many of these are highly productive in shrimps, crabs, oysters, clams, and a variety of fish. From discussions with Indian scientists, it would appear that brackish water resources in India have not been utilized to the extent to which resources from the fresh water or marine environment have. Also, a number of scientists involved in research on brackish water biology feel that they are completely eclipsed in those organizations which are intended to emphasize marine or fresh water biology. Several have expressed the need for workers in brackish water biology to become more familiar with

colleagues and research in the estuarine environment and the Symposium is intended to provide this opportunity as well as to permit the normal exchange of information. Sanjeeva Raj expressed the hope that a long-term program of research in the estuarine environment could be discussed at the Symposium and that, conceivably, an estuarine biological association of India might be formed for promoting studies in fresh water biology. (John D. Costlow, Jr.)

ICES MEETING IN IRELAND

The 57th Statutory Meeting of the International Council for the Exploration of the Seas (ICES) was held at the Royal Dublin Society, Dublin from 29 Sept to 8 October, 1969, with some 250 scientists and administrators in attendance. Founded in 1902, ICES is the oldest international organization in the field of fisheries and oceanography. Its purpose is to encourage the scientific study of the Northeast Atlantic Ocean and adjacent waters with the primary aim of improving and maintaining the fisheries of that area. The Council consists of 17 member countries (Finland, Sweden, Norway, Denmark, Germany, Netherlands, Belgium, Ireland, Great Britain, France, Spain, Portugal, Italy, Poland, USSR, Iceland and Canada) each represented by two officially appointed delegates. The United States, although not a member, was represented by an "observer" delegation. As such, as with other "observer" or "guest" groups attending, such as Food and Agricultural Organization (FAO)/Rome, International Commission for the Northwest Atlantic Fisheries (ICNAF) and Scientific Committee on Oceanic Research (SCOR), US delegates participate fully in the scientific sessions but may not attend administrative meetings, vote on any official action or hold position on the Council. Meeting locations alternate between Charlottenlund, Denmark, the permanent headquarters of ICES, and another member country. Arrangements for this meeting were handled by Dr. A.E.G. Went (Director, Fisheries Division, Dept. of Agriculture and Fisheries, Dublin) as Council President.

Most of the program consisted of meetings of the 12 regular committees, sessions being held concurrently, where various research and administrative problems were discussed and a number of scientific reports presented. As I was able to attend only a portion of these meetings I report here on the activities of two committees.

The Fisheries Improvement Committee, Mr. Bernt I. Dybern, (Institute of Marine Research, Lysekil, Sweden) Chairman, heard 26 reports. Highlights were:

a. Although many kinds of oil pollution can be expected to occur in the marine environment, the largest volume must certainly be from crude oil accidentally spilled during shipment between the fields and the refineries. A report by Dr. W. Kühnhold (Institut für Meereskunde der Universität Kiel) presented the results of an experimental study of the effects on the eggs and larvae of cod and herring of water-soluble substances obtained from crude oil samples. Developing stages of these species were used since they are found in the surface waters and would be exposed to substances dissolving from oil slicks. The experiments indicated that such substances are much less toxic than those obtained from refined oil products and that toxicities differ between crude oil samples as to origin -- in this case Iran, Libya and Venezuela. The discussion following brought out the problem of extrapolating experimental results to "at sea" conditions but there was general agreement that we need much more experimental data to develop oil pollution control programs - we cannot merely wait for field-study conditions as presented by the "Torrey Canyon" and Santa Barbara disasters!

b. Several reports by UK and Scandinavian scientists dealt with pesticide residue levels in a variety of marine animals and emphasized the wide dispersal of pesticides in the marine environment from airborne chemical treatments and with water run-off from the land. Notably lacking, I felt, were reports dealing with the effects of chronic exposure to chemical pollutants at levels less than toxic and metabolic studies of the uptake, retention and elimination of chemical pollutants. The discussion clearly indicated that the members felt too much environmental monitoring and LD50 experimental toxicity studies were being undertaken as compared with studies to determine what changes are actually occurring in plant and animal ecosystems as a result of the broad scale use of agricultural chemicals.

c. The report of Mr. A.C. Simpson (Fisheries Laboratory, Burnham-on-Crouch, England), "The benefits and dangers in the introduction of fish and shellfish to the ECES area from other parts of the world," was a most important and timely contribution with the current emphasis being placed on aquaculture. He pointed out that such introductions, as now handled by industry and fisheries agencies, are under rather loose control, at best, and should be a matter of serious concern to each member country. Simpson considers the possibility of introducing competitors, predators and disease organisms extremely high, and he documented several instances where it has occurred with disastrous results. He suggested that the Fisheries Improvement Committee serve as a review board within ICES for any plan by a member country to import an exotic species, whether with the intent to establish a reproducing population in their waters or for cultural (young to harvest) purposes alone, and that each country develop regulations to control such importation of non-endemic species. As evidence of the "no-control" aspect presently operating in most countries, the French reported, at a different committee meeting, the introduction of 50 tons of Japanese seed oysters, Crassostrea gigas, into their waters. This was done with full knowledge that the Eastern oyster drill, Urosalpinx cinerea, was introduced into Great Britain with similar transplants of the American oyster, Crassostrea virginica, some years ago and has had a serious predator impact on oyster production in British waters ever since.

d. Developed countries require large amounts of sand for industrial and building purposes and the cheapest source is to dredge it from the sea bottom. Commercial fishing interests frequently complain about the adverse effects of such operations: hydrogen-sulfide poisoning of fish, damage to nets and gear and ecological changes resulting in a decline in fish populations. In Sweden, where 600,000 cubic meters of sand is authorized for removal from the Öresund in 1969, where some 1500 metric tons of fish are also produced annually, a study by Mr. H. Ackefors and Dr. S.H. Fonselius (Institute of Marine Research, Lysekil, Sweden), "Preliminary investigations on the effect of sand suction work on the bottom in the Öresund," found that: (1) Although hydrogen-sulfide levels are high in the immediate area during dredging, they are quickly reduced and significant levels cannot be detected after several hours; (2) In most areas the bottom had holes and furrows for a short period of time but within 2-3 weeks these filled in and could not be detected; some areas, however, did retain deep holes and furrows for extended periods, and (3) Some bottom-dwelling forms are killed by sediment deposition following dredging but counts from bottom samples taken several months after the dredging operation did not suggest significant differences in the benthic fauna when compared with counts from non-dredged areas nearby. It was generally concluded that while sand-dredging operations may not always be as serious as claimed they should be restricted to areas least suitable for fishing and provision made for compensation to the fishing industry when direct evidence of damage to fish and/or fishing grounds is obtained.

Mr. Dybern continues as Chairman of this Committee for another year.

The Shellfish and Benthos Committee, Mr. A.C. Simpson, Chairman, heard 47 reports. Highlights were:

a. A number of reports were presented by scientists from France, Portugal and the UK concerning the problem of gill disease in the Portuguese oyster, Crassostrea angulata. First noted in France in 1967, it has resulted in serious mortalities of this species in France and Portugal as well as in British waters where seed oysters, imported annually from Portugal, are planted on commercial grounds. A similar disease has been found in the common mussel, Mytilus edulis, and in some specimens of the Japanese oyster, Crassostrea gigas, which were transplanted into French oyster-growing areas for commercial purposes. The latter species, however, does not appear to be the source of the disease as it has not been reported in oysters in Japan. The Committee recommended that research be continued on this problem with more emphasis being placed on microbiological studies in an effort to determine the causitive organism, method of transmission, etc.

b. Mr. H.J. Thomas (Marine Laboratory, Aberdeen, Scotland) gave

an interesting report summarizing information on the distribution and catch of squid, primarily Loligo forbesi, in Scottish waters. Until 1955 the catch was used exclusively as bait by the long-line fishery. Since then an export trade has developed in Europe for fresh frozen squid which has opened markets at all Scottish ports. Although squid are generally caught incidentally in other fisheries, during 1962 and 1963, when haddock were scarce, some vessels fished exclusively for squid and catches reached their peak during that period with 901.7 metric tons landed at a value of $175,500.00 in 1962. Catches have decreased since, due in part to fluctuations in abundance on the fishing grounds, averaging no more than 100 metric tons between 1964-1968. With the price per metric ton at $250.00 in 1968 the export trade is expanding and it is probable that some Scottish vessels will again fish for squid. This would require smaller mesh nets, since 60% of the squid population can "escape" from the nets now in use, and could pose some problems regarding mesh regulations currently in effect for the North Atlantic fisheries. The Committee recommended that similar studies be undertaken in other countries having squid fisheries, particularly Spain and Portugal, and that complementary biological research be intensified in this little known group of molluscs.

c. A report by Mr. M.S. Rolfe (Fisheries Laboratory, Burnham-on-Crouch, England), "The determination of the abundance of escallops and of the efficiency of the Baird escallop dredge" and another by Mr. N.M. Kerr (Industrial Development Unit, White Fish Authority, Hull, England) "The continuous delivery dredge - a new method for harvesting cockles," generated considerable discussion about gear development for shellfisheries. It was obvious that, as in the United States, much less research has been done in the ICES countries on shellfish gear than for finfish gear. Thus it is quite possible that significant production increases and manpower reductions can be realized with increased engineering and technological effort on shellfish-harvesting gear.

Dr. F.A. Gibson (Fisheries Division, Dept. of Agriculture and Fisheries, Dublin, Ireland) was elected to serve as Chairman for next year.

An invited paper, "The Role of Submersibles in Marine Research," was presented in open session by Mr. J. Arthur Posgay (Bureau of Commercial Fisheries, Woods Hole, Mass.). He reviewed the general development and activities of such underwater craft over the past several years with emphasis on their suitability to carry out biological observations and collect material from the ocean bottom. His talk was illustrated with color slides showing a number of types of existing submersibles, both US and foreign, through which Mr. Posgay pointed out their special capabilities. It was generally agreed that while the cost of such craft was very high, both to construct and operate, they provide a means of "on site" study in the ocean that is unique and cannot be approached by any gear handled from a surface vessel. It would seem that much more extensive use should be programmed for existing craft relative to fisheries and marine biological research.

Two symposia, "Physical Variability in the North Atlantic" and "The Biochemical and Serological Identification of Fish Stocks," which I did not attend, were held under the sponsorship of the Council the week prior to the general meeting. The papers presented at each will be published and information as to their availability, other ICES publications and general information about ICES can be obtained from: Mr. Hans Tambs-Lyche, Secretary General, ICES, Charlottenlund Slot, Charlottenlund DK-2920, Denmark. (J.E. Hanks)

COBLAMED EXERCISE

An air-sea interaction exercise to study the spatial behavior of inertial internal waves and the related thermal and mechanical structure of the atmosphere was carried out some 60 miles south of Toulon during the entire month of September 1969 under the sponsorship of NATO's Subcommittee of Oceanographic Research. The following report reflects the observations of Dr. Amos Shaler, Special Consultant to NATO, Scientific Affairs Division, who observed the exercise.

Three primary conclusions were reached: (1) new electronic instrumentation can provide either continuously or continually the same kinds of information as have been in the past obtained by manual, repetitive, shipboard methods; (2) for air-sea

interaction studies it is both possible and sufficient to make essentially continuous readings at vertical intervals of approximately a few decimeters near the surface and of a few meters from there down to some one or two hundred meters, and in the atmosphere at similar intervals to some hundred hundreds of meters, the sensor lines being horizontally separated by a few miles in the water, more in the air; (3) arrays of unmanned automated buoys can now transmit information by telemetry or store it on recoverable tape as reliably as can classical ship expeditions and, potentially, at much lower cost; (4) provided the entire sea system (sensors, storage, transfer) is standardized and digitized from the beginning to make it compatible with the data processing system, it is possible to reduce millions of data points in a month, analyze them in three, and produce a final scientific report in under a year.

The expedition included the French Bouée Laboratoire as the center of a triangular array of three tight-moored SACLANTCEN automatic buoys and of an orthogonal pair of lines of ship stations each terminated by either a Norwegian or Italian buoy. The station ships were the French Origny and the Belgian Mechelen, while the SACLANTCEN Maria Paolina and the Italian Bannock serviced the array in turns of two weeks each. Bathythermometry and meteorological data were taken by the ships (BT's every 15 minutes, meteo every hour, XBT's every three hours, and a series of bathysondes).

A British team measured humidities and temperatures above the water to 1800 meters, utilizing twin-balloon systems carrying modified Graw radiosondes twice a day for 8 days; rockets for determining wind fine-structure; and a method of using an array of dyed-oil patches and floats to follow to a depth of 2 meters the fine structure of surface water motion. All proved satisfactory even in relatively bad weather. The wind and current vectors were clearly shown to spiral towards the south by more than 45° as the depth increased from zero to 2 meters.

The quartz thermometer of a Belgian buoy, and a modified Kelvin-Hughes echosounder utilized by the Belgian team, performed admirably. The results obtained with these devices, together with earlier results in continuous water analysis obtained in the Alboran Sea, demonstrated that continuous readings of temperature, water chemistry, and density are economically feasible and far more meaningful than are manual measurements made at intervals by bathythermometry and laboratory analysis of water samples. The echosounding and the high-resolution temperature scans clearly show the internal waves as well as water stratifications, inversions, shears, turbulence, and biological scattering layers.

The French Bouée Laboratoire, which joined the exercise from 10 Sept to 12 October, measured air and water temperatures (30 levels), water currents (5 levels), solar radiation, meteorological conditions, and infrared water-surface temperature; a satellite buoy gave a fixed-depth thermocline temperature trace. By RANA it also recorded a stable month-long inertial oscillation. The RANA was also used to fix ship and buoy positions.

The SACLANTCEN array of modular automatic buoys, recording digitally on tape as well as telemetering on command, showed that the French "Mécabolier" current meters perform well to 1500 meters and are seaworthy. The buoys were tight-moored with the help of a diving team, which proved its worth in launching and servicing buoys. The array also measured temperatures at a variety of levels.

A Norwegian buoy performed properly, automatically recording every ten minutes and then telemetering on command measurements from a line of thermistors and current meters. Signals were clear and reliable to ten miles, and a transmitting distance of 50 nautical miles should be attainable in the near future. The Italian buoy was moored in a complex manner to a submerged float; it made current and temperature measurements in both air and sea.

In all, approximately a half-million measurements per day were taken. Reduction of data is being carried out at the laboratories which provided the buoys and ships, the results then going to SACLANTCEN for an integrated analysis. Much of the reduction is already completed; the rest will be done before January.

A second follow-up expedition is planned in the same area for the two-layer season (3 February to 8 March).

The ships Jean Charcot, Discovery, and, possibly, Origny and Bannock will join the Bouée Laboratoire on fixed stations, forming a 5-mile grid in a 15 x 110-mile rectangle. The wind-induced deep-water perturbations will be sought out and studied with Stommel vertical current meters, abyssal BT's, and more conventional equipment.

The entire operation will have cost the NATO Division of Scientific Affairs some $20,000. In contrast, about $500,000 plus some 5 to 10 man-years of scientific and technical effort will have been contributed in all by the national institutes and by SACLANTCEN. People from eight of the NATO nations are participating, including oceanographers and meteorologists from both sides of the Atlantic. (R. Hanson)

MAMBO - SECOND INTERNATIONAL COURSE ON TROPICAL MARINE BIOLOGY

In spite of the rise in tensions in the Middle East, reports from Israel, as well as from individuals in other countries, suggest that the course in tropical marine biology at Eilat was highly successful. The first of such courses was given in Eilat in December 1966 and, on the basis of its merits, MAMBO has requested the Hebrew Univ., Jerusalem, to organize a comparable course every two to three years. The course was funded through the Hebrew Univ. and the Oceanographic and Limnological Research Company of Israel. This included travel funds for three guest lecturers from other countries. Travel funds for the students were provided by the Secretary General of MAMBO, Dr. Peter Dohrn. Also participating, as well as providing assistance in many indirect ways, was the Smithsonian Institution of the United States.

The course was attended by 12 graduate students, two of whom came from Turkey, two from Romania, two from Yugoslavia, three from Italy, and three from Israel. Guest lecturers from abroad included two from West Germany, one from France, and one from the US. Twelve Israeli scientists were involved in the lectures and laboratory sessions and represented a number of institutes with marine science interests in Israel. The main theme along which the lectures were planned was the concept of the general tropical environment and ecological information pertaining to the Red Sea fauna. Animal groups were not discussed separately as a rule, and in this respect the course differed from the one given in 1966. A sizable portion of the program was allotted to field work, also viewed as an improvement over the 1966 course. The completion of the new Marine Biological Laboratory in Eilat assisted greatly in the presentation of the lectures and provided modern facilities for laboratory work. Offshore benthos collecting was emphasized, but the lack of a larger research vessel continued to make such collecting a rather hazardous task.

Selection of students again proved to be one of the most difficult problems. In the interest of assembling a truly international body of students, occasional compromises were necessary in the general academic level. It is felt that the results were quite satisfactory, although the view was expressed that it was unfortunate that French students were not included in this course. The course was conducted in English, a language which none of the participants knew perfectly, but the majority were able to understand and use it.

Included in the course was a two-day sight-seeing tour, encompassing the Northern Region of Israel. This included visits to the Lake Kinnerat Limnological Laboratory and the Sea Fisheries Research Institute in Haifa. The old city of Jerusalem, Bethlehem, Jericho, and the Dead Sea were also included as points of interest.

Lectures covered a broad base and included such topics as the structure and evolution of the Red Sea, the oceanography of the Red Sea, history, fisheries, and archaeology in the Red Sea area, interaction between aquatic microorganisms, the problem of migration through the Suez Canal, structure and zonation of the Red Sea coral reefs, a comparison of Red Sea reef types and those from the Caribbean Sea, the behavior of reef invetebrates, and general coral reef ecology and the influence of ecological factors on distribution and growth density of settled fauna within the coral reefs.

It would certainly appear that this is one way in which MAMBO can constructively contribute to the Marine Sciences in the Mediterranean area, and it can only be hoped that the activities of this organization will be continued and expanded in the years to come. (John D. Costlow, Jr.)

Recent Publications of Interest

1. Fisheries of Scotland - Report for 1968, Department of Agriculture and Fisheries for Scotland. Her Majesty's Stationery Office (obtainable from British Information Service, 845 Third Avenue, New York, NY 10022, price approx. $1.00). Provides a good review of Scottish fisheries, the fishing fleet, research programs and management/surveillance activities (55 pps.).

2. Water Pollution Research 1968, Water Pollution Research Laboratory, Ministry of Technology, England and Wales. Her Majesty's Stationery Office (British Information Service, address as above, price approx. $2.50). A report on the current research programs in water pollution for England and Wales with chapters on Coastal Pollution, Estuaries, Effects of Pollution on Fish and Microbiology plus several others on water treatment processes (195 pps.).

PHYSICAL SCIENCES

PHYSICS APPLICATIONS AT THE INTERNATIONAL RESEARCH AND DEVELOPMENT CO. LTD (IRD)

Mr. D. Smart at the IRD, Newcastle upon Tyne, England, has been working on various ideas which prove helpful to the physician through the use of physical principles. He has recently developed a convenient, hand-held pulsed laser that can be used to spot-weld detached retinas back into place and thus prevent further damage. In several cases of eye injury, the iris had been pulled to one side so that light was admitted to the eye only from an off-axis direction or in some cases, not at all. By use of the laser, a new opening through the damaged iris was cut so that light was readmitted in a more normal manner. Although not at all as satisfactory as the original eye, useful vision has been restored. Another use of the laser has been to cut a hole through the exterior structure of the eyeball to provide a small opening by which some of the vitreous humor of the interior of the eye could escape to the outside. This is used in cases of glaucoma in which increasing internal pressure causes the eyeball to expand, thus making it impossible for the lens to form images on the retina.

In another application of physics to the medical problems of the eye, it has been found that partial freezing of the eye lens in a cataract operation makes the lens much less subject to fracture, occurences which occasionally greatly increase the duration of the operation, since the surgeon must then carefully pick out all the bits and pieces of the lens.

In a completely different area of medicine, Smart has been studying the use of electrical stimulation of labor. This has involved making power spectra of the pressures developed during labor contractions and a determination of the relation between muscle tensions and the pressures developed in the uterus. The spectral studies show that during normal labor, the variation of pressure with frequency is a smoothly varied function which appears almost sinusoidal. It appears possible that premature labor can be suppressed by the use of electrical stimulation in a pattern which breaks up the normal frequency pattern. Similarly, labor can be induced through the application of an electrical stimulus which follows the pattern of normal labor. A simple battery-operated stimulator that can be carried on a belt has been developed. It can be simply put on when it is desirable to start labor.

In other areas physicists at IRD have been working with the use of lasers, for instance a CO_2 laser operated at 10.6 μm with power up to 100 W, for sealing and cutting plastics. At much lower powers, the CO_2 laser has been used as a monitor in automatic machine control. The position of a cutting tool on a lathe can be determined by the observation of interference fringes, and the speed of motion of the cutting tool is determined by fringe counting at frequencies up to 50 kHz. Also, studies with the helium neon laser have been made to attempt to determine the power level at which physiological and neurological damage will just begin. Another use is in various survey problems, for instance, in alignment of motor car assembly lines and in the determination of the distortion of the deck of a 250,000-ton tanker caused by motions in seaway.

Holography is being used to observe small distortions in surfaces in the hope that an industrial use may be found for the ideas developed by Drs. Burch and Enos at the National Physical Laboratory. Holograms

developed through the use of the ruby laser with a 20-nsec pulse length are being utilized to study the formation of sprays in fuel injectors. A similar technique is being employed to study the behavior of the electric arc resulting in the opening of air-blast circuit breakers. It is felt that the 3-D nature of the holograph image will be much more satisfactory for the study of problems of this sort than ordinary high speed photography.

In the solid state laboratory a program for the increased resistance of solar cells to loss of sensitivity caused by radiation damage is being followed. The use of vacuum deposited CdS appears to offer some help, although Si cells appear to be more promising. The CdS is not a single crystal cell, and is able to withstand deformation. It is lower in cost but inferior in efficiency. A 5 or 6% conversion seems a logical goal for the CdS cell. (A.B. Focke)

SOME PHYSICS AT THE UNIVERSITY OF GENEVA

The Institute of Theoretical Physics together with the Elementary Particles Institute and the Institute for the Study of the Physics of Condensed Matter form the School of Physics of the University of Geneva. Most of the work and personnel of the Elementary Particle Institute are located at the European Center for Nuclear Research (CERN) about ten miles from the center of the downtown area of the city of Geneva. As might be expected, the program of this Institute centers about the big accelerator at CERN. There are about fifty people working in the Institute, which is headed by Prof. Ernst Heer, who also holds the position of Vice Rector of the School of Physics.

The Institute for the Study of the Physics of Condensed Matter is located on the main campus of the University in central Geneva. It is about the same size as the Elementary Particles group, and is headed by Prof. Martin Peter who is also Rector of the School. Work in this Institute centers around the subjects of superconductivity, magnetism and the interaction of ions with Fermi surfaces in metals and alloys. Considerable effort is being expended on the study of magnetic and acoustic properties, as well as resistivity and thermoelectric power in single crystals of palladium-rhodium alloys. The crystals are grown both by the Czochralski and Bridgman methods. Measurements are made in the temperature range of 1.5 K to room temperature, and in magnetic fields varying from 0 to 60 kG. The magnetic properties of the crystals are measured using the Faraday method, while the measurements of the velocity of sound are made by pulsed techniques. A study is also being made of the effect of magnetic impurities in superconductors.

The Institute for Theoretical Physics is headed by Prof. J.M. Jauch, and is also located on the main campus of the University. The thirty people in this group are to a large extent working in support of the other two Institutes. Jauch himself is studying scattering theory. Prof. Stückelberg is writing what he intends to be his final work on the foundations of thermodynamics. Prof. Charles Enz and his group of graduate students are working on solid state theory, collective modes of phonons, crystal dynamics, and second, third and fourth sound. A small group headed by Ruegg is developing an elementary particle theory, models of scattering processes, exchange processes and generalizing these models to several particles. M. Guenin is generalizing to four dimensions (x, y, z, t) the exactly solvable models which have been worked out by Glimm and Jaffe which were restricted to two dimensions only (x, t).

Jauch has had a great deal of success with a teaching technique which he calls his little seminar. He describes this as an unstructured informal bull session which lasts one to two hours each Friday afternoon. One session with which he was particularly pleased resulted in the suggestion of using the Josephson effect for the determination of the ratio of e to h. In addition to the little seminars, each research group holds its own seminar. Formally invited and student speakers address these latter. All three Institutes appear to be very active, and although they were visited in midsummer, a very considerable amount of work was obviously in progress. (A.B. Focke)

PSYCHOLOGICAL SCIENCES

INSTITUTE OF PSYCHOLOGY AT THE UNIVERSITY OF BOLOGNA

The Istituto di Psicologia della Facoltà Medica dell' Università di Bologna is a separate institute and department but an integral part of the medical school of the world's oldest university. Located immediately behind a restored segment of the city's ancient wall, it occupies a handsome, modern-looking, functional laboratory building on Viale Berti Pichat in Bologna. There is a separate department of psychiatry in the medical school so that, even though all staff members of the institute are MD's and psychiatrists, they teach psychology and their research is primarily psychological in nature, although much of the research, as might be inferred from the medical school setting (physically akimbo to the institutes of physiology and of anatomy), lies in the borders of physiology, of psychiatric therapy, or of stress reactions.

There are no formal departments of psychology in the Italian Università degli Studi (c.f. ONRL 1-68, H.W. Sinaiko), so psychology is under the umbrella of medicine. Of the permanent staff members of the institute, most have titles in the school of medicine, but some have titles, and teach in, faculties of political science, education, or letters and philosophy, while maintaining their primary affiliation with the institute.

The medical school is of a size not known in USA. At Bologna this term are about 4,000 medical students in the six-year course (which would include much of what American students take in pre-medical courses). Of these somewhat more than 300 are Americans.

Experimental psychology is taught to all students and the institute's lecture hall, seating 230, is grandly equipped, even including built-in facilities for simultaneous translations for occasions when non-Italians lecture to the students.

The director of the institute is Professor Renzo Canestrari, who began the work in psychology at Bologna eighteen years ago. The work achieved formal status when the institute was established in 1961 and Dr. Canestrari assumed the chair.

The building which houses the offices, laboratories, and clinics is now three years old. It is well instrumented, especially for work in sensory deprivation, sleep loss, and perception.

All permanent staff members have visited the USA to see work at various psychological laboratories and some have spent one to three years on Fulbright or other arrangements. The published bibliography for the six years 1961 through 1966 shows 209 scientific papers in a wide variety of journals, chiefly Italian of course. The fact that English is now the preferred language for communication in science and medicine (when my professors were graduate students it was German) creates a difficulty for some staff, for translation into English is burdensome, and MD's do not typically spend extra training time on language. Of course, the language requirement for the PhD in the USA has less than optimal outcomes as well.

Canestrari and Prof. Mario Farnè, who is also professor of psychology at the University of Ferrara, are carrying on a long series of experiments in visual perception, stimulated by the demonstrations of 15 or 20 years ago by Adelbert Ames of Dartmouth. They have some data and some theoretical formulations which throw new light on these phenomena.

Prof. Marino Bosinelli and Dr. Sergio Molinari are involved in experiments on sleep and sleep deprivation. Molinari spent the academic year 1968-69 at the Univ. of Wyoming and then the Univ. of Chicago, and visited several other sleep laboratories in the USA, including the Navy's at San Diego.

Dr. Carlo Arrigo Umiltà is involved in studies of perception and the central nervous system. Dr. Paolo Bonaiuto is working in the area of sensory deprivation and its effects on behavior.

Whether industrious and productive institutes like Canestrari's become formal departments of psychology depends, of course, on the decisions of the central ministry for education in Rome. It seems inevitable that such action will be taken and thus allow psychology the same status in Italy as it has elsewhere in the scholarly world. (Walter L. Wilkins, Navy Medical Neuropsychiatric Research Unit, San Diego)

NEWS & NOTES

The Rector Magnificent and the Rector of the University of Louvain have announced the death on 2 November, 1969, of Prof. Adolphe van Tiggelen at the age of 54. Prof. van Tiggelen, a member of the Académie Royale de Belgique, was in general inorganic and analytical chemistry and spectroscopy in the Department of Chemistry of the University, but his researches were concerned with combustion, flames, explosions, reaction kinetics, and high temperature chemistry. (C.P. Smyth)

Announcement has been made of the pending retirement in early 1970 of Prof. Dr. Gunnar Thorson, Director of the Marine Biological Laboratory, Univ. of Copenhagen, Helsingnør, Denmark, since its founding in 1958. For many years Prof. Thorson has been an international authority on the ecology of benthic marine invertebrates and has played a leading role in initiating studies of marine bottom communities throughout the world. Hopefully, relief from the administrative routine will allow him time to complete his monographic work on prosobranch mollusks based on a worldwide collection of these gastropods and their egg masses. Contract support for a number of Prof.Thorson's research programs has been provided by the Office of Naval Research over the past seven years. (J.E. Hanks)

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C-16-69 Motion in Molecular Crystals General Discussion, The Faraday Society, Oxford, 16-18 Sept 69, by C.P. Smyth.

C-17-69 The Shapes of Small Molecules: An Oxford Inorganic Discussion Sponsored by the Chemical Society, 26 Sept 1969, by C.P. Smyth

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